PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in or relating to Apparatus for Measuring Alternating Electric Magnitudes.

We, S. A. Off. Elettromecc. Scarpa & Magnano, an Italian Joint Stock Company, of Via Fiume, Savona, Italy, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It is known that bushings may be utilised for measuring current flowing therethrough. For this purpose a transformer is employed which comprises a magnetic circuit including a ring fitted on the bushing and a coil wound on the ring and connected in series with a suitable ammeter. When a current flows through the conductor traversing the bushing, a current is induced in the coil forming the secondary circuit of the transformer, the primary circuit whereof is formed by the conductor itself, this current being proportional to the main current which may thus be measured.

The range of use of the known apparatus is limited to these current measurements and when it is desired to measure other alternating quantities, separate auxiliary circuits must be employed.

The object of this invention is to extend the use of apparatus of this type to the measurement of any alternating electric magnitude, thereby considerably simplifying the connections of the measuring instruments.

According to this invention there is placed on the bushing a condenser coating having a certain capacity with respect to the bushing conductor and earthed through an auxiliary coil wound on the annular core of the transformer. By this arrangement when no current flows through the bushing conductor, a capacity current flows through the auxiliary coil which is proportional to the voltage of the conductor, and serves for measuring the said voltage by connecting a measuring instrument in the circuit of the auxiliary coil, or preferably by measuring the current induced in the main coil of the transformer.

When a current flows through the bushing conductor, the effects of current and voltage of the conductor are added up in the circuit of the main coil of the transformer and by suitably coupling the transformers of one or more bushings it will be possible to measure at the same time the voltage of the same phase with respect to earth or between one phase and another, the current of one or more phases, the synchronism, frequency, power etc.

The accompanying drawings show diagramatically by way of example, a construction of the apparatus according to this invention.

Figure 1 shows diagrammatically an instrument transformer employed in connection with a bushing in the usual manner;

Figure 2 is a diagram of Figure 1.

Figure 3 shows diagrammatically the transformer according to this invention;

Figure 4 shows the invention in connection with a switch of the usual type.

In Figures 1 and 2 of the drawing, B is the bushing provided with a central conductor P, a fastening flange F and a ring type transformer, of which the magnetic core is denoted by M and the coil by S. The conductor P forms the primary circuit and the coil S the secondary circuit of the transformer. An instrument A, e.g. an ammeter, placed in the circuit of the coil S gives indications which are proportional to the intensity of the current in the conductor P and therefore serve exclusively for measuring the said current.

Figure 3 shows diagrammatically the arrangement of the transformer, according to this invention, said transformer being influenced by the current flowing through the conductor P and by the voltage of this latter at the same time. On the drawing the transformer includes the magnetic circuit M, the main coil S, in the circuit of which the measuring instrument A is placed, as previously, and further an auxiliary coil T earthed at one end at E and connected at its other end to a condenser coating C, surrounding the bushing and having a certain capacity with respect to the conductor P. In this case when no current flows through the conductor P, but a voltage is applied to

this latter, a capacity current flows through the coil T which is proportional t the voltage on the conductor P and an induced current flows through the winding S which can be measured by the instrument A and is directly proportional to the voltage in the conductor P.

When current flows through the conductor P, the effects of both current and voltage of the conductor P are added up on the main winding S. These effects may be utilised by suitably coupling two or a plurality of transformers according to this invention, in order to measure all electric alternating magnitudes.

Figure 4 shows by way of example a measuring instrument in connection with a switch I of the usual type. In this Figure P1, P2 denote the central conductors of the bushings of the same switch phase; C1, C2 are the auxiliary coatings of the bushings; M1, M2 the transformers of the ring type, provided with main windings S1, S2 and auxiliary windings T1, T2.

The auxiliary windings T1, T2 are connected at one end to the condenser coatings C1 and C2 through the conductors 1 and 2, respectively, and at their other end to earth E through their common conductor 3.

The main windings S1 and S2 have their ends, which are of opposed polarity connected together by means of the conductors 4 and 5 respectively, measuring instrument A and conductor 6. Choke coils R1 and R2 may be connected in parallel with the ammeter A, said coils being coupled by the conductor 7, in which the commutator K is connected. Another measuring instrument V is in shunt between the conductors 7 and 4 through the conductor 8 and the fixed contacts 9 and 10 of the commutator K are connected to the terminals of the instrument.

Switches 11 and 12, respectively, are connected in the conductors 5 and 6 between the windings S1, S2 and choke coils R1, R2, respectively; switch 13 is placed on the conductor 8 and switch 14 is connected on the ammeter circuit.

The capacity current of the bushing flows wholly or in part through the windings T1 and T2. Supposing the switch I is open, no current flows through P1 and P2. A current flows through S1 and S2 which is proportional to that flowing through T1 and T2, i.e. proportional to the voltages of P1 and P2. If the commutator K be closed at 10 and switch 11 be open, while all the other switches are closed, a circuit is closed leading from a pole of the winding S2 over the conductor 4, switch 13 conductor 8, instrument V, contact 10, ch ke coil R2, conductor 6, and switch 12 to the other pole of the winding S2. The instrument V indicates therefore the voltage of P2. When the switch 12 is open and the switch 11 is closed, a circuit is closed leading from one pole of the winding S1, over the switch 11, conductor 5, choke coil R1, conductor 7, instrument V, conductor 8 and switch 13 to the other pole of the winding S1. The instrument V now indicates the voltage of P1. When the switches 13 and 14 are opened and the movable contact of the commutator K is brought on the contact 9, a circuit is closed going from one pole of the winding S1 through the switch 11, conductor 5, choke coil R1, conductor 7, instrument V, conductor 8, commutator K, choke coil R2, conductor 6, switch 12, winding S2 and conductor 4, to the other pole of the winding S1. The instrument V denotes the vectorial sum of both currents proportional to the voltages of the conductors P1 and P2 respectively. The device may therefore be used also as a synchroniser.

Supposing now the switch I is closed. A current flows through the conductors P1 and P2 inducing in the windings S1 and S2 a current which is added up to that induced by T1 and T2. When all the switches are closed and the commutator K is closed at 10, the effects of the currents induced by T1 and T2 are added on the instrument V, and are mutually annulled in the circuit of the instrument A which is therefore practically unaffected by the currents induced by T1 and T2.

The currents induced by P1 and P2 on S1 and S2 being opposed, their effects are added up in the circuit of the instrument A, and are mutually annulled in the instrument V, which is therefore practically unaffected by the currents induced by the conductors P1 and P2 in the windings S1 and S2.

The indications of the instrument A and V are therefore identical to and as exact as those obtainable by separately measuring the voltage and current, while but one transformer for each bushing is required.

It is obvious that all the apparatus required for measuring the other electric magnitudes as well as relays for remote measurements and the automatic regulation of electric machines and plants may be put in the circuits of the windings S1 and S2.

When the transformers according to this invention are used in connection with bushings of different phases, the voltages between one phase and another may be measured and any necessary measure for controlling electric plants may be taken.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Apparatus for measuring alternating electric magnitudes comprising a transformer combined with a bushing, characterised in that the transformer comprises a primary winding traversed by the line current and consisting of the central bushing conductor, a secondary winding in which the measuring instrument or a relay is placed and an auxiliary winding traversed by all or part of the capacity current of the bushing.

2. Apparatus as claimed in Claim 1, wherein the auxiliary coil is connected at one end to an auxiliary coating, placed on the bushing and having a certain capacity with respect to the bushing conductor, and is earthed at its other end.

3. A method of measuring alternating electric magnitudes by means of an apparatus as claimed in Claims 1 and 2, wherein the transformers are connected to two bushings of the same phase and are coupled in such manner as to measure simultaneously and separately the voltage on the bushings and the current flowing therethrough.

4. A method of measuring alternating electric magnitudes by means of apparatus as claimed in Claims 1 and 2, wherein the transformers are connected to the bushings of the same or of different phases and are coupled in such manner as to measure the voltage between one phase and another or between phase and earth, current on one or more phases, synchronism, frequency and power.

5. A method as claimed in Claims 3 or 4, wherein relays for any remote control are put in the circuits of the main windings of the transformers, as claimed in Claims 1 and 2.

6. Apparatus for measuring alternating electric magnitudes substantially as described with reference to Figure 4 of the accompanying drawings.

Dated this 4th day of March, 1930.

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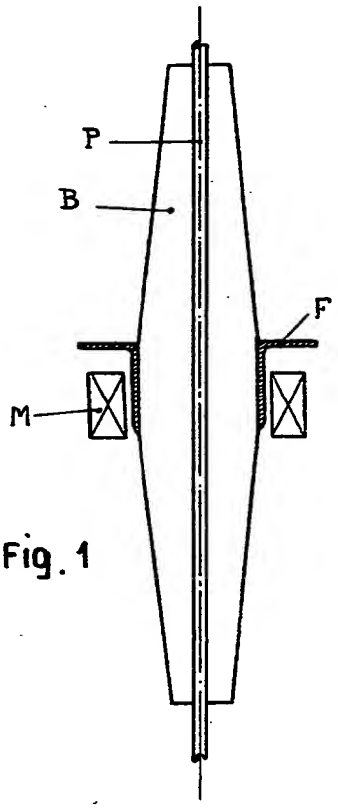

Fig. 1

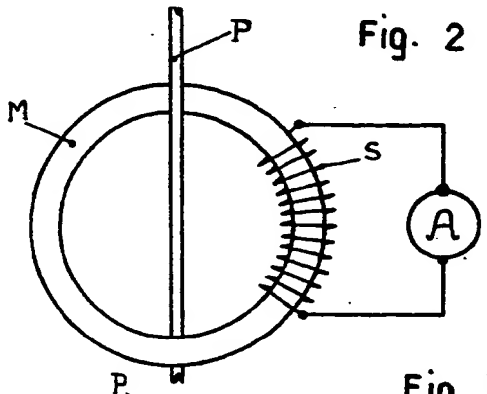

Fig. 2

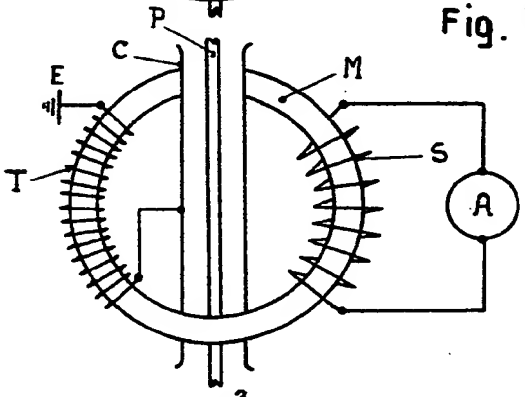

Fig. 3

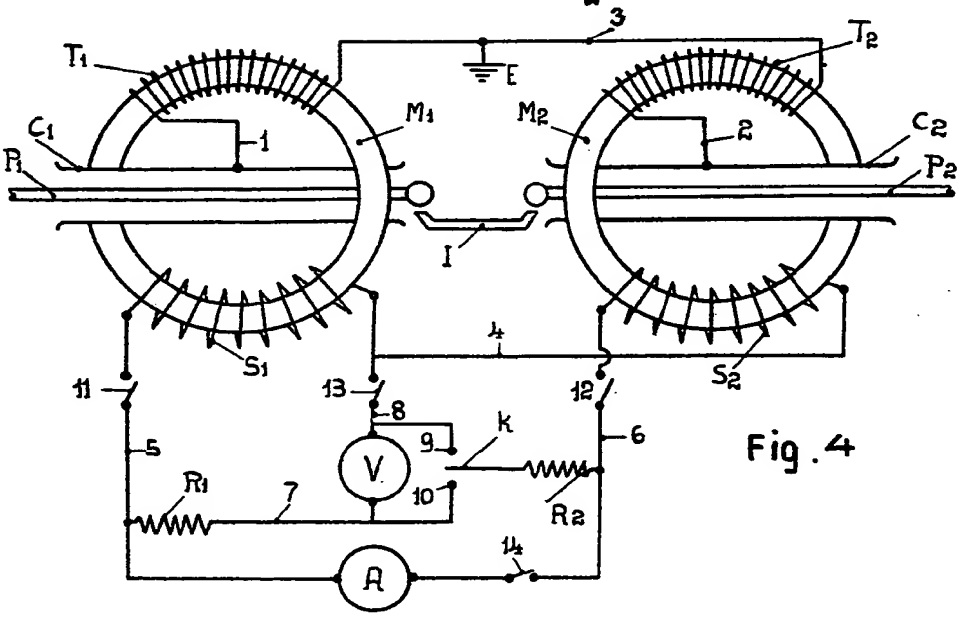

Fig. 4

Charles & Read Ltd. Photo Litho.